PETER 6.4

ecology and environment, inc.

International Specialists in the Environment

333 SW Fifth Avenue
Portland, Oregon 97204
Tel: 503/248-5600, Fax: 503/248-5577

Technical Memorandum

To: Kevin Parrett, Project Manager-- McCormick and Baxter Superfund Site

Date: March 11, 2004

From: John Montgomery

Subject: January 15, 2004 through February 25, 2004 Barrier Wall Performance Monitoring Monthly Report

1.0 Introduction

This technical memorandum presents a monthly status report on groundwater movement and nonaqueous phase liquid (NAPL) thickness results inside and outside the barrier wall at the McCormick and Baxter site in Portland, Oregon. The technical memorandum presents hydraulic head measurements and gradients, groundwater contour maps, transducer plots, NAPL gauging and extraction results. The monitoring data was collected during the period from January 15, 2004 through February 25, 2004. Figures, tables and transducer plots are attached at the end of this technical memorandum.

The monitoring system at the M&B site is used to evaluate the functional performance of the containment system and to determine whether the containment system is performing the designed function. As defined in the monitoring plan, the main objectives and goals of this monitoring are as follows:

- Understand changes in groundwater flow outside and inside the barrier containment system;
- Understand changes in gradients/fluxes from the bluff to the river on the north and south sides of the containment system;
- Understand groundwater flow and contaminant movement along the riverfront downgradient of the containment system;

- Determine the effects of groundwater flow toward Willamette Cove in relation to existing NAPL seeps; and

- Determine the effects of river stage and tidal influence on groundwater levels and flow.

2.0 Water Level Monitoring

Automated Water Level Data Collection

Groundwater level data is currently being collected from select monitoring wells using automated pressure transducers and manually operated electronic water level indicators.

Approximately 45 new monitoring wells and 27 existing monitoring wells were monitored during the reporting period to determine groundwater elevations and calculate gradients inside and outside the barrier wall. Twenty-four select monitoring wells are equipped with pressure transducers to collect water level measurements at hourly intervals (Table 1). The pressure transducers are equipped with internal batteries to allow for in-situ placement in the well. Data is currently downloaded at monthly intervals for each transducer location using a hand-held PDA. Groundwater level data is collected from the remainder of the monitoring wells manually once per week during the reporting period.

The monitoring wells designated with an *s* (e.g., MW-36s) are wells screened in the shallow zone. Those wells designated with an *i* (e.g., MW-36i) are screened in the intermediate zone, and those wells designated with a *d* (e.g., MW-36d) are screened in the deep zone. All deep zone monitoring wells were screened beneath the total barrier wall depth in that location. Figure 1 shows the locations of the monitoring well network.

River stage data is recorded daily from the Morrison Bridge and corrected for river stage in front of the M&B site. E & E is evaluating the potential for installing a pressure transducer and radio transmitter in front of the site to monitor river stage in conjunction with monitoring well data collection. Potential locations for the transducer include using a remnant dock dolphin or using the BNRR bridge pier.

2.1 Groundwater Flow and Gradients

Water levels recorded inside the wall were higher relative to water levels outside the barrier wall in well clusters along the riverfront. Figure 2 presents a groundwater contour map for January 15 and 16, 2004. Groundwater flow inside the wall showed flow toward the FWDA with some flattening of the water table in that area. Calculated horizontal gradients are 0.004 ft/ft from MW-50s to MW-36s. The upland portion of the site shows groundwater mounding behind the barrier wall with locally reversed gradients toward the bluff. Groundwater flow is diverted around the upland portion of the wall toward Willamette Cove and the southeastern portion of the site. Head inside the wall in the FWDA was between 3 to 4 feet, and in the TFA was between 5 to 6 feet.

Figure 3 presents a groundwater contour map for February 16 and 17, 2004. Groundwater flow inside the wall continues to showed flow toward the FWDA with more pronounced flattening of the water table in that area. Groundwater flow continues to be diverted around the upland portion of the wall toward Willamette Cove and the southeastern portion of the site. This is consistent with flows patterns from the previous month. Shallow groundwater elevations in wells located on the inside of the barrier wall increased by an average of 1.3 ft, with the largest increase of 2.44 ft at MW-7s. The head difference between the inside of the wall and the outside the wall, also increased in the both the FWDA (between 4 to 5 feet) and the TFA (between 7 and 8 feet). Shallow groundwater elevations on the outside of the wall decreased in the Willamette Cove and along the river front, and increased slightly in the upland portion directly behind the wall (an average of 0.38 feet).

Vertical groundwater gradients were calculated using data from February 23, 2004 for several of the nested wells installed inside and outside the barrier wall. Table 2 presents the calculated vertical gradients between the shallow, intermediate and deep aquifer zones during both rising and ebb tides. Vertical gradients are generally down inside and outside of the wall in the both the FWDA (wells 36, 37, 40, 41) and the TFA (44 and 45). The effect of rising vs ebb tide is not immediately apparent; the effect of lag time will be further evaluated.

2.2 Transducer Plots

Transducer plots were developed for select monitoring wells (See figure 1) inside and outside the barrier wall during the reporting period and are included as an attachment following the tables. The plots compare monthly water level elevations inside the barrier wall versus water level elevations outside the barrier wall and river elevation data. Water levels outside the wall correlated well with river stage along the riverfront portion of the barrier wall. Water levels inside the wall showed a steady increase from mid-January 2004 through the reporting period, along with increasing precipitation and periods of river stage increase and decrease. Water levels indicate groundwater mounding is occurring inside the wall in the southeastern portion of the site in the TFA.

3.0 NAPL Thickness and Extraction

Light-phase non-aqueous phase liquid (LNAPL) and dense-phase non-aqueous liquid (DNAPL) measurements were recorded at several site wells during the reporting period. Monitoring wells in the TFA and the FWDA are normally measured for NAPL thickness twice monthly. When LNAPL exceeding 0.5 ft thickness is encountered during routine monitoring, it is manually extracted using passive skimmers or bailers. When DNAPL exceeding 1.0ft thickness is encountered during monitoring it is extracted using pneumatic pumps. E & E is continuing to evaluate methods for extracting DNAPL of lesser thickness, but historically, this has been problematic. Tables 3 presents LNAPL and DNAPL thicknesses measured during February 2004, and the amounts of NAPL extracted at each well following the measurement. Clean wells (not containing NAPL) are gauged weekly for water levels and total depths, and to verify that NAPL has not infiltrated these wells. Figures 4 and 5 show the monitoring well locations of the wells that exhibited LNAPL and/or DNAPL during January and February respectively.

LNAPL

The measured LNAPL thickness ranged from 0.01 foot in MW-32i, MW-Ds, and MW-Gs to 5.02 feet in EW-15s. Seven wells in the FWDA, one well in the TFA, MW-32i and MW-1s exhibited LNAPL during this reporting period (Table 3).

LNAPL thickness measured in February 2004 was comparable to thickness measured in January 2004 at the site wells, except MW-56s. Previously, little to no LNAPL was detected in MW-56s. However, in late February 2004, LNAPL was measured at 0.43 feet in MW-56s, and approximately 1.5 gallons of LNAPL were subsequently extracted.

DNAPL

Measurable DNAPL was recorded in eight wells during the reporting period. The measured DNAPL thickness ranged from 0.16 feet in EW-24s to 10.56 feet in MW-20i.

The DNAPL thickness readings at MW-20i ranged from a high of 10.56 feet to a low of 10.50 feet. Four wells in the FWDA and four wells in the TFA contained DNAPL during this reporting period (Table 3).

No significant difference in DNAPL thickness measurements was observed from January 2004 to February 2004.

The re-appearance of DNAPL may be attributable to the barrier wall construction activities, which involved operation of heavy equipment and subsurface vibrations along the barrier wall to a depth of 80 feet. The resultant ground pressures and vibrations may have increased the ability of DNAPL to permeate site soils and enter nearby wells. During "normal" site conditions, the high dynamic viscosity of DNAPL, combined with molecular attraction of the DNAPL fluid to soil particles, likely creates substantial resistance to the flow of DNAPL into wells. E & E will continue to carefully monitor the DNAPL levels in site wells to determine whether the recent DNAPL mobilization will continue, or whether the DNAPL thickness in the wells will gradually diminish.

NAPL Extraction

A total of 19.5 gallons of LNAPL was manually extracted during the reporting period using disposable bailers.

A total of approximately 60 gallons of DNAPL was extracted on March 3 and March 4, 2004. While technically outside the current reporting period, these DNAPL extractions were included in this report because they are related to the NAPL gauging conducted on February 23, 2004.

NAPL extraction volumes increased significantly from previous reporting periods, particularly at EW-1s and MW-20i. NAPL appears to be more plentiful, and the new site O&M subcontractor (Munitor Construction) is skilled in extraction techniques.

Table 3 lists the NAPL thickness recorded at the site and the amount of NAPL extracted during the reporting period.

3.2 Seep Visual Inspection and Monitoring

Visual inspections of seep areas were conducted bi-weekly during the reporting period, including the existing seep areas in Willamette Cove and along the shoreline in front of the FWDA and TFA. During the bi-weekly visual inspections, the entire riverfront was checked for the presence of new seep areas, sheen observed on the surface water, and any other observations. No additional seep areas or sheen was observed in Willamette Cove or along the riverfront portion of the site. In November 2003, the seep areas became submerged and have continued to be submerged through this reporting period, subsequently, no sheen or other visual evidence has been observed.

4.0 Summary Observations

Water levels rose inside and outside the wall area, with the largest increases observed inside of the wall. Water level contours define an area of mounding and deflection on the "backside" of the wall with shallow groundwater flowing around the sides of the wall. This suggests the wall is tight with no evidence of leakage.

Intermediate and deep aquifer wells located on both the inside and outside of the barrier wall along the riverfront continue to mimic the water levels in the Willamette River. Shallow aquifer wells located on the outside of the barrier wall along the riverfront also mimic the water levels in the Willamette River. Water levels in the shallow aquifer wells located on the inside of the wall were observed to be higher in elevation than those on the outside (from 1.5' to a 8.0' difference) and increased from the January to February reporting period, and do not tend to rise and fall with the tides. This also indicates isolation of groundwater inside the wall.

Shallow water levels on the inside of the wall located in the TFA are typically higher than shallow water levels on the inside of the wall located in the FWDA. Flow is generally from the TFA to the FWDA.

Water levels will continue to be monitored and reported on a monthly basis. Shallow aquifer wells MW-36s, MW-37s, MW-44s and MW-45s will be monitored on a weekly basis, as they continue to rise. E & E and DEQ are considering options for ensuring the water does not overtop the wall from the inside. These options currently include maintaining the wall height at its current elevation of approximately 19 to 19.5 ft NGVD as opposed to cutting it to the ordinary high water level (approx 16.6 ft NGVD) as previously designed, and potentially digging a gravel-filled drainage trench from the TFA toward the FWDA in order to facilitate groundwater flow. Groundwater modeling is being revisited for its potential to serve as a predictive tool.

NAPL monitoring and extraction will continue on a bi-weekly basis, and patterns of NAPL appearance and rebound will be noted and used to optimize removal activities. Observed NAPL during the reporting period was fairly consistent with previous monitoring. This was the largest monthly extraction of DNAPL since January of 1998, and the fourth largest since the monthly extraction was implemented.

Table 1
Performance Monitoring Well Network
McCormick and Baxter Creosoting Company Site
Portland, Oregon

Well Identification	Monitoring Frequency	Measurement Method	Screen Interval (feet BGS)
Existing Wells			
MW-As	Bi-Monthly	Manual/Water level indicator	22 to 27
MW-32i	Bi-Monthly	Manual/Water level indicator	48.3 to 58.3
MW-Ks	Bi-Monthly	Manual/Water level indicator	13.5 to 33.5
MW-33s	Bi-Monthly	Manual/Water level indicator	19.37 to 29.37
MW-Js	Bi-Monthly	Manual/Water level indicator	13 to 33
MW-14s	Bi-Monthly	Manual/Water level indicator	18.34 to 38.34
MW-Cs	Bi-Monthly	Manual/Water level indicator	19 to 24
MW-15s	Bi-Monthly	Manual/Water level indicator	10.97 to 30.97
MW-18s	Bi-Monthly	Manual/Water level indicator	23.95 to 43.95
EW-22s	Bi-Monthly	Manual/Water level indicator	20 to 40
MW-17s	Bi-Monthly	Manual/Water level indicator	14.85 to 34.85
EW-23s	Bi-Monthly	Manual/Water level indicator	18 to 38
MW-34i	Bi-Monthly	Manual/Water level indicator	55.2 to 75.2
MW-31s	Bi-Monthly	Manual/Water level indicator	9.42 to 19.42
MW-Os	Bi-Monthly	Manual/Water level indicator	13 to 35
MW-5s	Bi-Monthly	Manual/Water level indicator	9.34 to 29.34
MW-2s	Bi-Monthly	Manual/Water level indicator	13.15 to 33.15
MW-3s	Bi-Monthly	Manual/Water level indicator	10.03 to 30.03
MW-7s	Bi-Monthly	Manual/Water level indicator	16.35 to 36.35
MW-8i	Bi-Monthly	Manual/Water level indicator	16.35 to 36.35
MW-23d	Bi-Monthly	Manual/Water level indicator	171.17 to 181.17
MW-LRs	Bi-Monthly	Manual/Water level indicator	14.8 to 34.8
MW-10s	Bi-Monthly	Manual/Water level indicator	14.60 to 34.60
MW-7-WC	Bi-Monthly	Manual/Water level indicator	25 to 35
MW-36s	Hourly	Pressure Transducer	12-22
MW-36i	Hourly	Pressure Transducer	40-45
MW-36d	Hourly	Pressure Transducer	80-85
MW-37s	Hourly	Pressure Transducer	12-22
MW-37i	Hourly	Pressure Transducer	40-45
MW-37d	Hourly	Pressure Transducer	80-85
MW-38s	Bi-Monthly	Manual/Water level indicator	12-22
MW-38i	Bi-Monthly	Manual/Water level indicator	40-45
MW-38d	Bi-Monthly	Manual/Water level indicator	80-85
MW-39s	Bi-Monthly	Manual/Water level indicator	12-22
MW-39i	Bi-Monthly	Manual/Water level indicator	40-45
MW-39d	Bi-Monthly	Manual/Water level indicator	80-85
MW-40s	Hourly	Pressure Transducer	12-22
MW-40i	Hourly	Pressure Transducer	40-45
MW-40d	Hourly	Pressure Transducer	80-85
MW-41s	Hourly	Pressure Transducer	12-22
MW-41i	Hourly	Pressure Transducer	40-45
MW-41d	Hourly	Pressure Transducer	80-85
MW-42s	Bi-Monthly	Manual/Water level indicator	TBD
MW-42i	Bi-Monthly	Manual/Water level indicator	40-45
MW-42d	Bi-Monthly	Manual/Water level indicator	80-85
MW-43s	Bi-Monthly	Manual/Water level indicator	12-22
MW-43i	Bi-Monthly	Manual/Water level indicator	40-45
MW-43d	Bi-Monthly	Manual/Water level indicator	80-85

Table 1
Performance Monitoring Well Network
McCormick and Baxter Creosoting Company Site
Portland, Oregon

Well Identification	Monitoring Frequency	Measurement Method	Screen Interval (feet BGS)
MW-44s	Hourly	Pressure Transducer	12-22
MW-44i	Hourly	Pressure Transducer	40-45
MW-44d	Hourly	Pressure Transducer	80-85
MW-45s	Hourly	Pressure Transducer	12-22
MW-45i	Hourly	Pressure Transducer	40-45
MW-45d	Hourly	Pressure Transducer	80-85
MW-46s	Bi-Monthly	Manual/Water level indicator	12-22
MW-47s	Bi-Monthly	Manual/Water level indicator	20-35
MW-48s	Bi-Monthly	Manual/Water level indicator	20-35
MW-49s	Bi-Monthly	Manual/Water level indicator	20-35
MW-50s	Hourly	Pressure Transducer	20-35
MW-51s	Hourly	Pressure Transducer	20-35
MW-52s	Bi-Monthly	Manual/Water level indicator	20-35
MW-53s	Bi-Monthly	Manual/Water level indicator	20-35
MW-54s	Hourly	Pressure Transducer	20-35
MW-55s	Hourly	Pressure Transducer	20-35
MW-56s	Bi-Monthly	Manual/Water level indicator	20-35
MW-57s	Bi-Monthly	Manual/Water level indicator	20-35
MW-58s	Hourly	Pressure Transducer	20-35
MW-58i	Bi-Monthly	Manual/Water level indicator	40-45
MW-58d	Hourly	Pressure Transducer	80-85

Table 2
VERTICAL GROUNDWATER ELEVATION GRADIENTS
February 23, 2004
McCORMICK & BAXTER CREOSOTING COMPANY
PORTLAND, OREGON

Well ID	Rising Tide (0600) Mid-point value		Ebb Tide (1200) Mid-point value	
MW-36s to MW-36d	0.08758	down	0.07127	down
MW-36s to MW-36i	0.1823	down	0.13470	down
MW-36i to MW-36d	0.01254	down	0.04875	down
MW-37s to MW-37d	0.006393	down	0.00176	down
MW-37s to MW-37i	0.02419	down	0.00466	down
MW-37i to MW-37d	0.004258	up	0.00000	down
MW-40s to MW-40d	0.115	down	0.08247	down
MW-40s to MW-40i	0.2209	down	0.18020	down
MW-40i to MW-40d	0.005269	down	0.00498	down
MW-41s to MW-41d	0.01359	down	0.00170	down
MW-41s to MW-41i	0.04098	down	0.00201	up
MW-41i to MW-41d	0.006472	up	0.00441	down
MW-44s to MW-44d	0.1241	down	0.11010	down
MW-44s to MW-44i	0.268	down	0.23370	down
MW-44i to MW-44d	0.01134	down	0.015460	up
MW-45s to MW-45d	0.01776	down	0.00135	down
MW-45s to MW-45i	0.03671	down	0.00208	down
MW-45i to MW-45d	0.004838	down	0.0008537	down

Note: Gradients calculated using EPA vertical gradient calculator.
http://www.epa.gov/athens/learn2model/part-two/onsite/vgradient02.htm

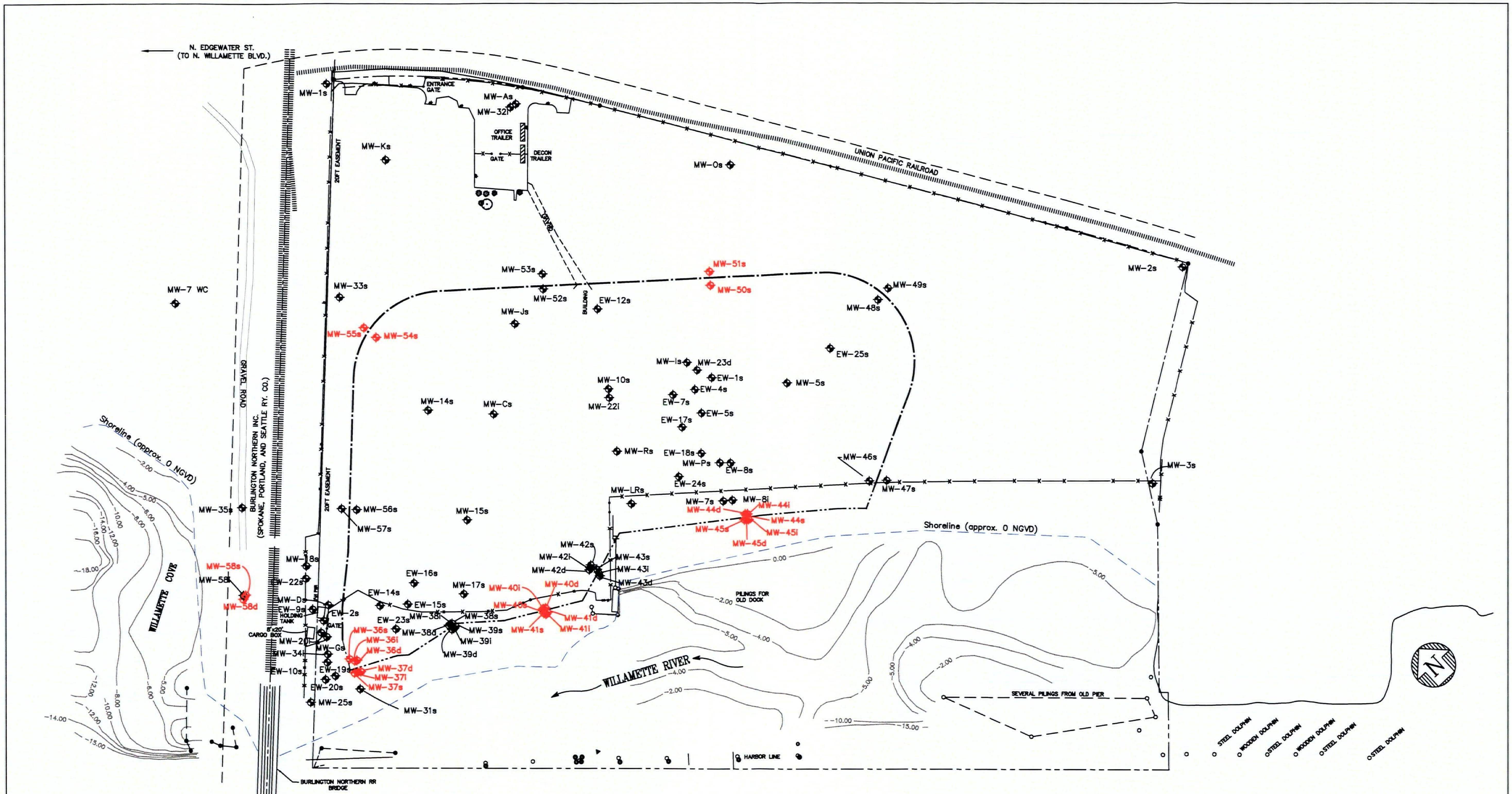
Table 3 LNAPL and DNAPL Measurement and Extraction Summary January 15 through February 25, 2004 McCormcik and Baxter Creosoting Company Site Porltand, Oregon			
Date Measured	**Well Number**	**Thickness (feet)**	**Extracted (Gallons)**
LNAPL			
2/12/04	EW-10s	0.39	0
2/12/04	EW-15s	5.02	7
2/12/04	EW-23s	1.48	3
2/12/04	MW-Ds	0.01	0
2/12/04	MW-Es	0.10	0
2/12/04	MW-Is	0.14	0
2/16/04	MW-32i	0.01	0
2/23/04	EW-10s	0.40	0
2/23/04	EW-15s	4.82	8
2/23/04	EW-23s	1.27	0
2/23/04	MW-56s	0.43	1.5
2/23/04	MW-Ds	0.01	0
2/23/04	MW-Es	0.12	0
2/23/04	MW-Gs	0.01	0
2/23/04	MW-Is	0.03	0
DNAPL			
2/12/04	MW-Is	4.75	0
2/12/04	MW-Gs	0.63	0
2/12/04	MW-Ds	1.40	0
2/12/04	MW-20i	10.50	0
2/12/04	EW-9s	0.90	0
2/12/04	EW-1s	5.96	0
2/23/04	MW-Is	4.76	3.5*
2/23/04	MW-Gs	0.57	1*
2/23/04	MW-Ds	1.42	2.5*
2/23/04	MW-20i	10.56	28*
2/23/04	EW-9s	0.70	0
2/23/04	EW-8s	0.96	0
2/23/04	EW-24s	0.16	0
2/23/04	EW-1s	5.89	25*

Table 4

GROUNDWATER ELEVATION GRADIENTS
McCORMICK & BAXTER CREOSOTING COMPANY
PORTLAND, OREGON

TFA Monitoring Wells						
Date	**MW-49s Groundwater Elevation (ft, MSL)**	**MW-47s Groundwater Elevation (ft, MSL)**	**Horizontal Distance (ft)**	**Angle of Flowpath Deviation (degrees)**	**Horizontal Gradient (ft/ft)**	**Horizontal Gradient (ft/mile)**
Jan-04	15.37	7.20	387.5	42	0.028	150
Feb-04	15.74	6.05	387.5	45	0.035	187
FWDA Monitoring Wells						
Date	**MW-50s Groundwater Elevation (ft, MSL)**	**MW-36s Groundwater Elevation (ft, MSL)**	**Horizontal Distance (ft)**	**Angle of Flowpath Deviation (degrees)**	**Horizontal Gradient (ft/ft)**	**Horizontal Gradient (ft/mile)**
Jan-04	13.12	9.44	1,090.40	6	0.003	18
Feb-04	14.44	10.53	1,090.40	11	0.004	19

Key:
ft = Feet.
ft/ft = Feet per foot.
ft/mile = Feet per mile.
FWDA = Former waste disposal area.
MSL = Mean sea level.
TFA = Tank farm area.



LEGEND

- WELL LOCATIONS
- WELL LOCATIONS (WITH TRANSDUCER)
- RAILROAD TRACKS
- PROPERTY LINE
- BARRIER WALL

SCALE IN FEET: 0 100 200 300

NO.	DATE	DWN	APP'D	DESCRIPTION

REVISIONS

ecology and environment, inc.
International Specialists in the Environment
Portland, Oregon

DESIGNED BY: M. OCHSNER

CHECKED BY:

DRAWN BY: E. YAO

APPROVED BY

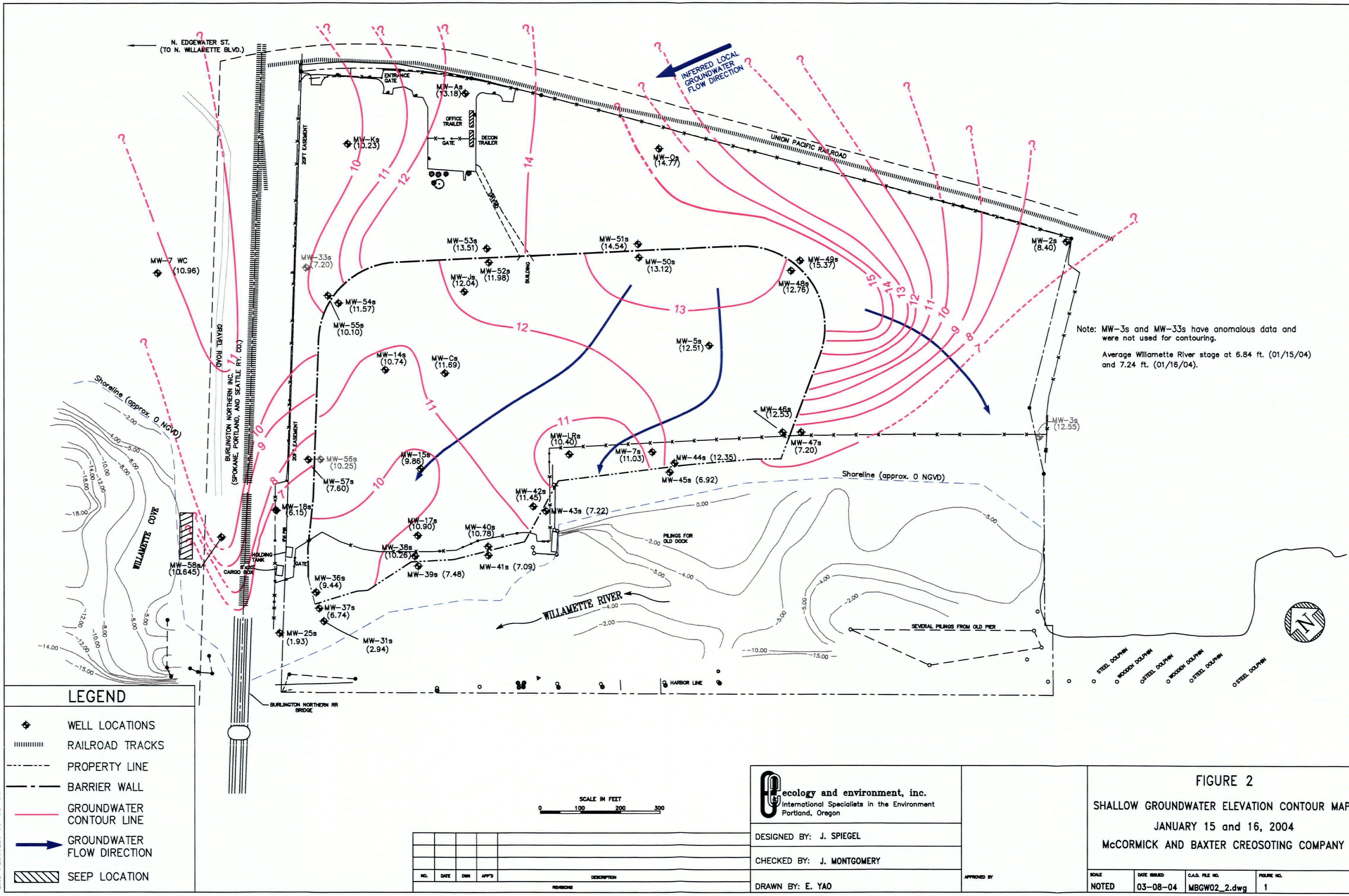
FIGURE 1

MONITORING WELL LOCATIONS

McCORMICK AND BAXTER CREOSOTING COMPANY

SCALE	DATE ISSUED	C.A.D. FILE NO.	FIGURE NO.
NOTED	03-05-04	MBGW02_1.dwg	1

BRG PLOTTED: 03-05-04



NO.	DATE	DWN	APP'D	DESCRIPTION

REVISIONS

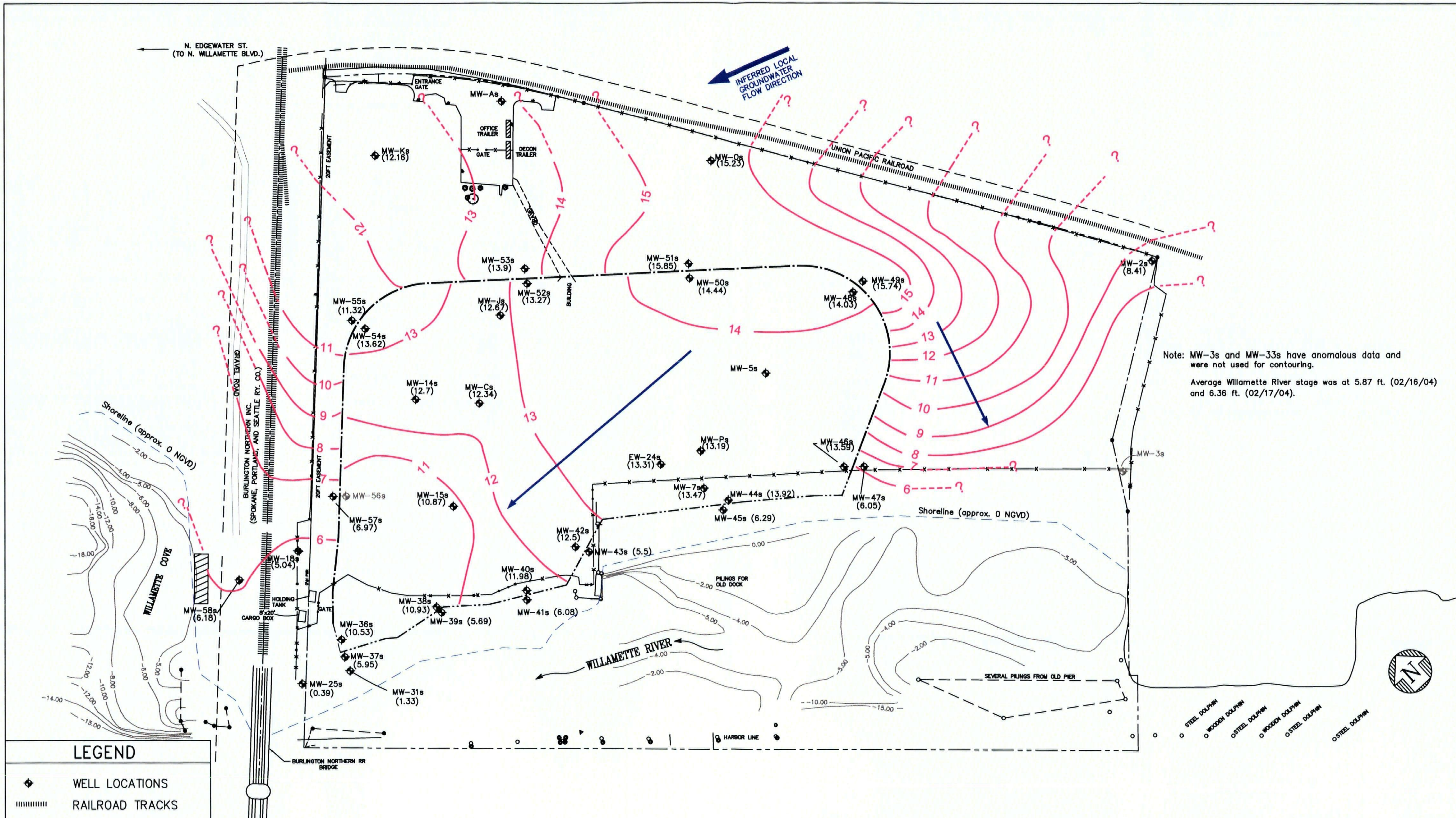
ecology and environment, inc.
International Specialists in the Environment
Portland, Oregon

DESIGNED BY: J. SPIEGEL
CHECKED BY: J. MONTGOMERY
DRAWN BY: E. YAO
APPROVED BY

FIGURE 2

SHALLOW GROUNDWATER ELEVATION CONTOUR MAP
JANUARY 15 and 16, 2004
McCORMICK AND BAXTER CREOSOTING COMPANY

SCALE	DATE ISSUED	C.A.D. FILE NO.	FIGURE NO.
NOTED	03-08-04	MBGW02_2.dwg	1



Note: MW-3s and MW-33s have anomalous data and were not used for contouring.

Average Willamette River stage was at 5.87 ft. (02/16/04) and 6.36 ft. (02/17/04).

SCALE IN FEET
0 100 200 300

LEGEND

- WELL LOCATIONS
- RAILROAD TRACKS
- PROPERTY LINE
- BARRIER WALL
- GROUNDWATER CONTOUR LINE
- GROUNDWATER FLOW DIRECTION
- SEEP LOCATION

BRG PLOTTED: 03-08-04

NO.	DATE	DWN	APP'D	DESCRIPTION

REVISIONS

ecology and environment, inc.
International Specialists in the Environment
Portland, Oregon

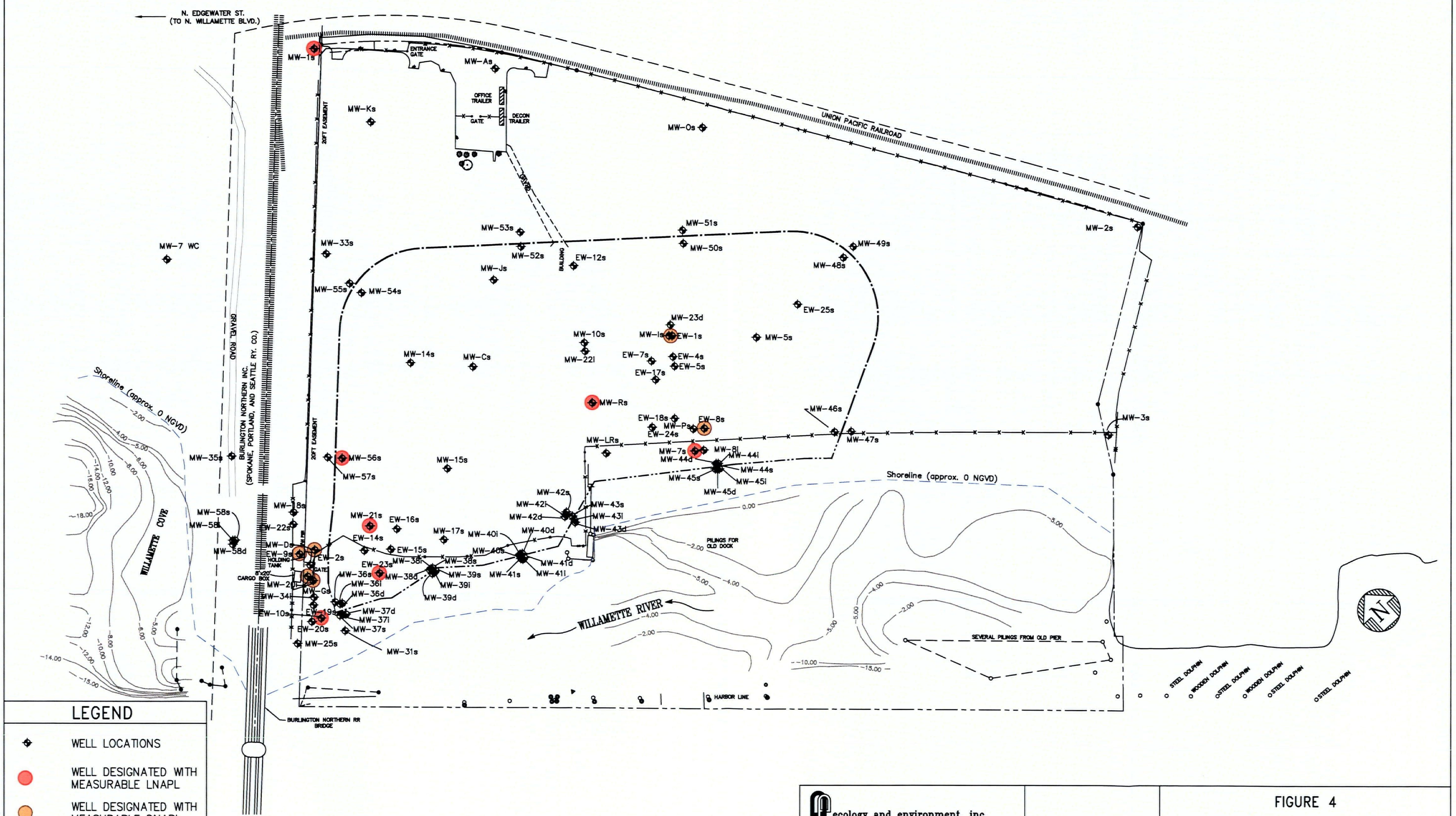
DESIGNED BY: J. SPIEGEL
CHECKED BY: J. MONTGOMERY
DRAWN BY: E. YAO

APPROVED BY

FIGURE 3

SHALLOW GROUNDWATER ELEVATION CONTOUR MAP
February 16 and 17, 2004
McCORMICK AND BAXTER CREOSOTING COMPANY

SCALE	DATE ISSUED	C.A.D. FILE NO.	FIGURE NO.
NOTED	03-08-04	MBGW02_3.dwg	1



LEGEND

- WELL LOCATIONS
- WELL DESIGNATED WITH MEASURABLE LNAPL
- WELL DESIGNATED WITH MEASURABLE DNAPL
- RAILROAD TRACKS
- PROPERTY LINE
- BARRIER WALL

BRG PLOTTED: 03-05-04

NO.	DATE	DWN	APP'D	DESCRIPTION
				REVISIONS

ecology and environment, inc.
International Specialists in the Environment
Portland, Oregon

DESIGNED BY: M. OCHSNER
CHECKED BY:
DRAWN BY: E. YAO
APPROVED BY

FIGURE 4
MONITORING WELL DETECTED WITH NAPL
NOVEMBER 21, 2003
McCORMICK AND BAXTER CREOSOTING COMPANY

SCALE	DATE ISSUED	C.A.D. FILE NO.	FIGURE NO.
NOTED	03-05-04	MBGW02_1.dwg	1

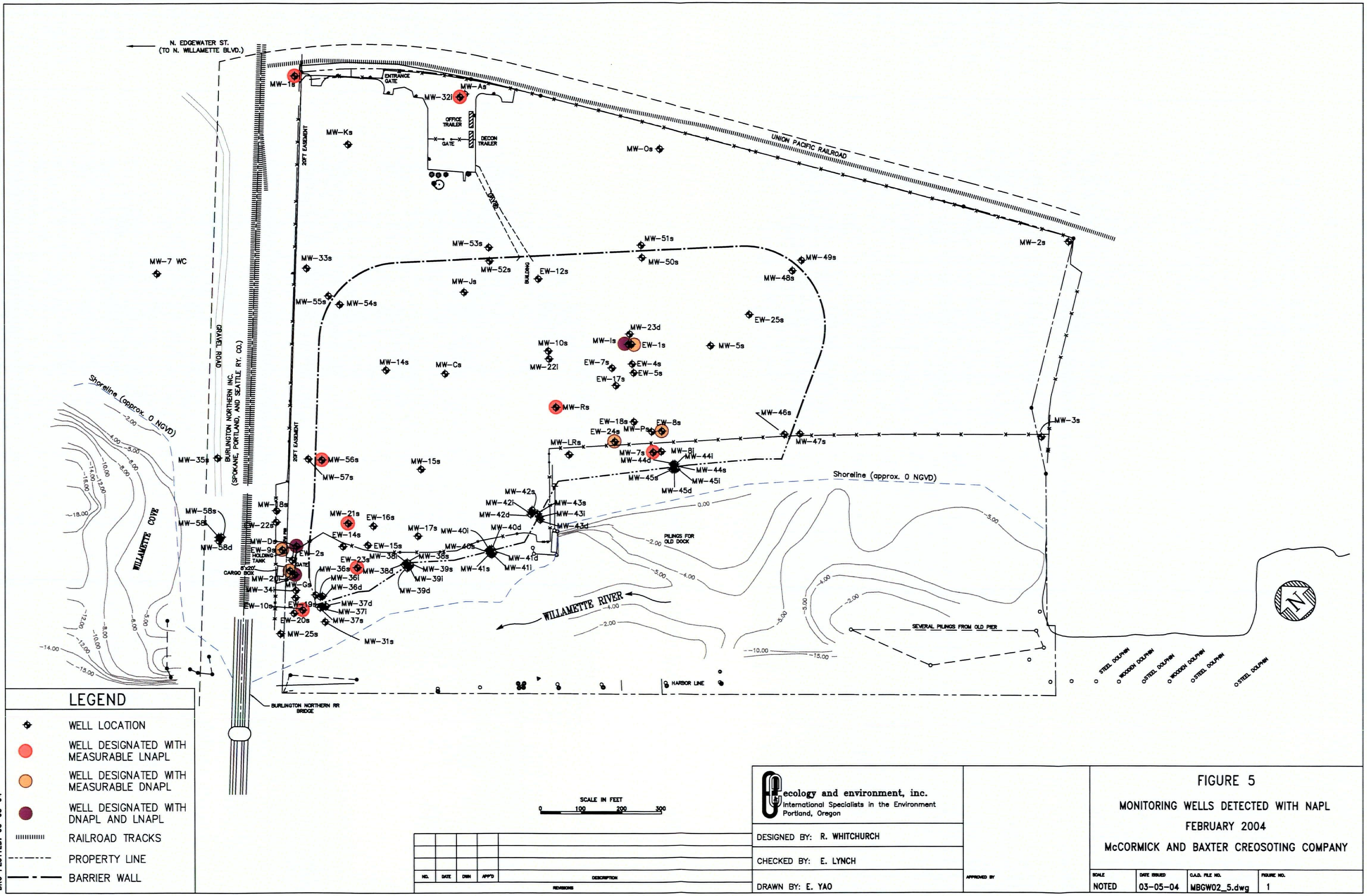


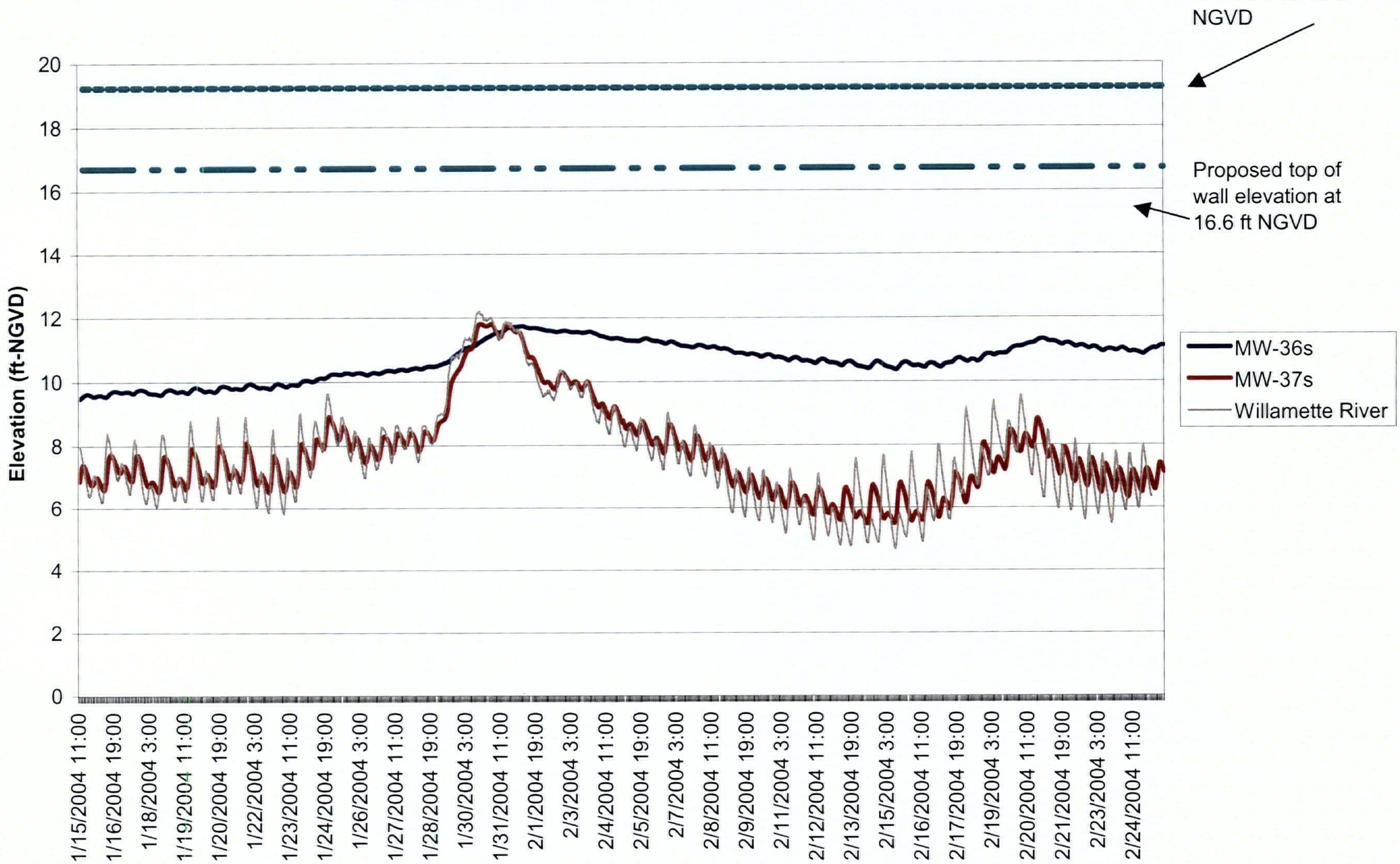
FIGURE 5

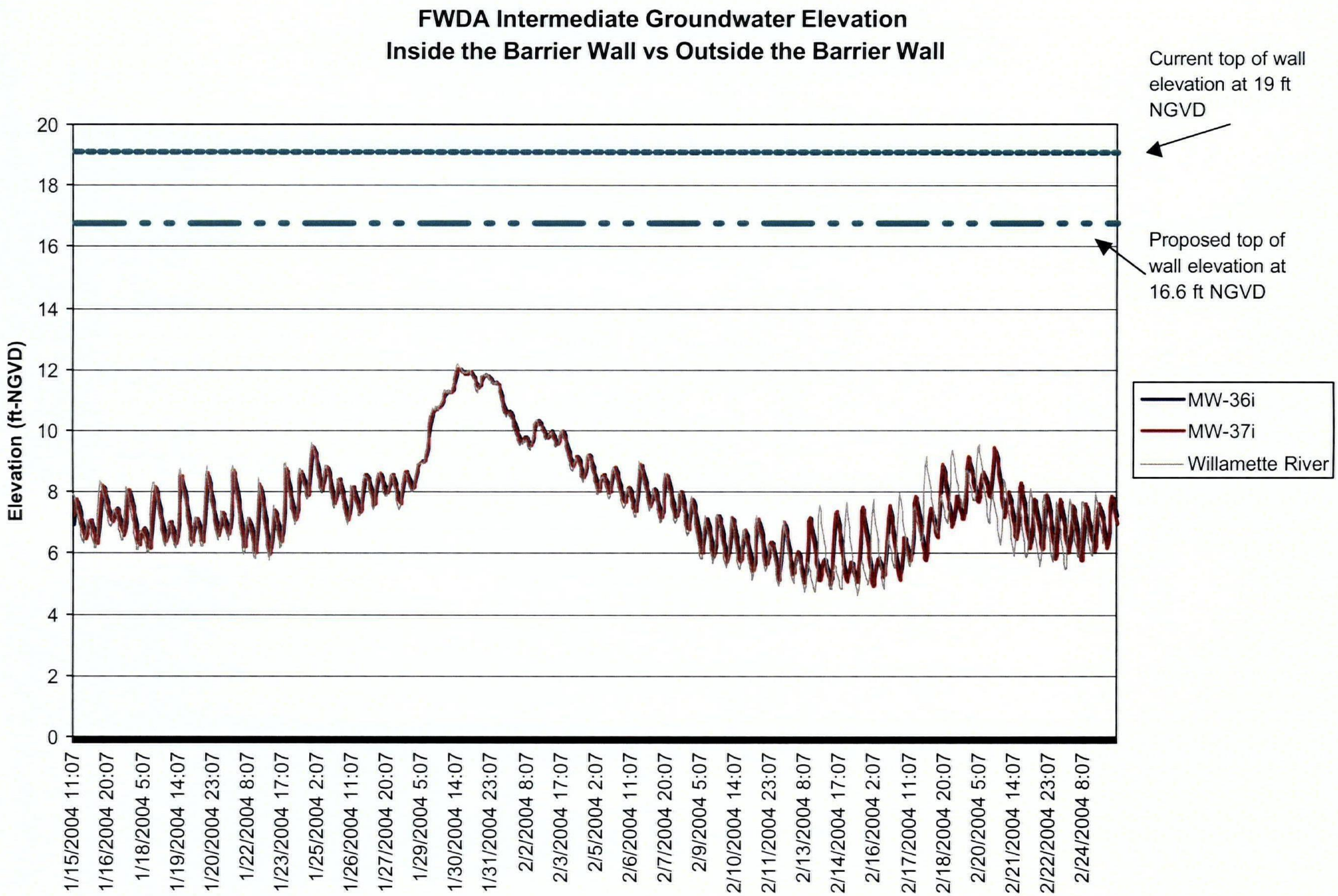
MONITORING WELLS DETECTED WITH NAPL

FEBRUARY 2004

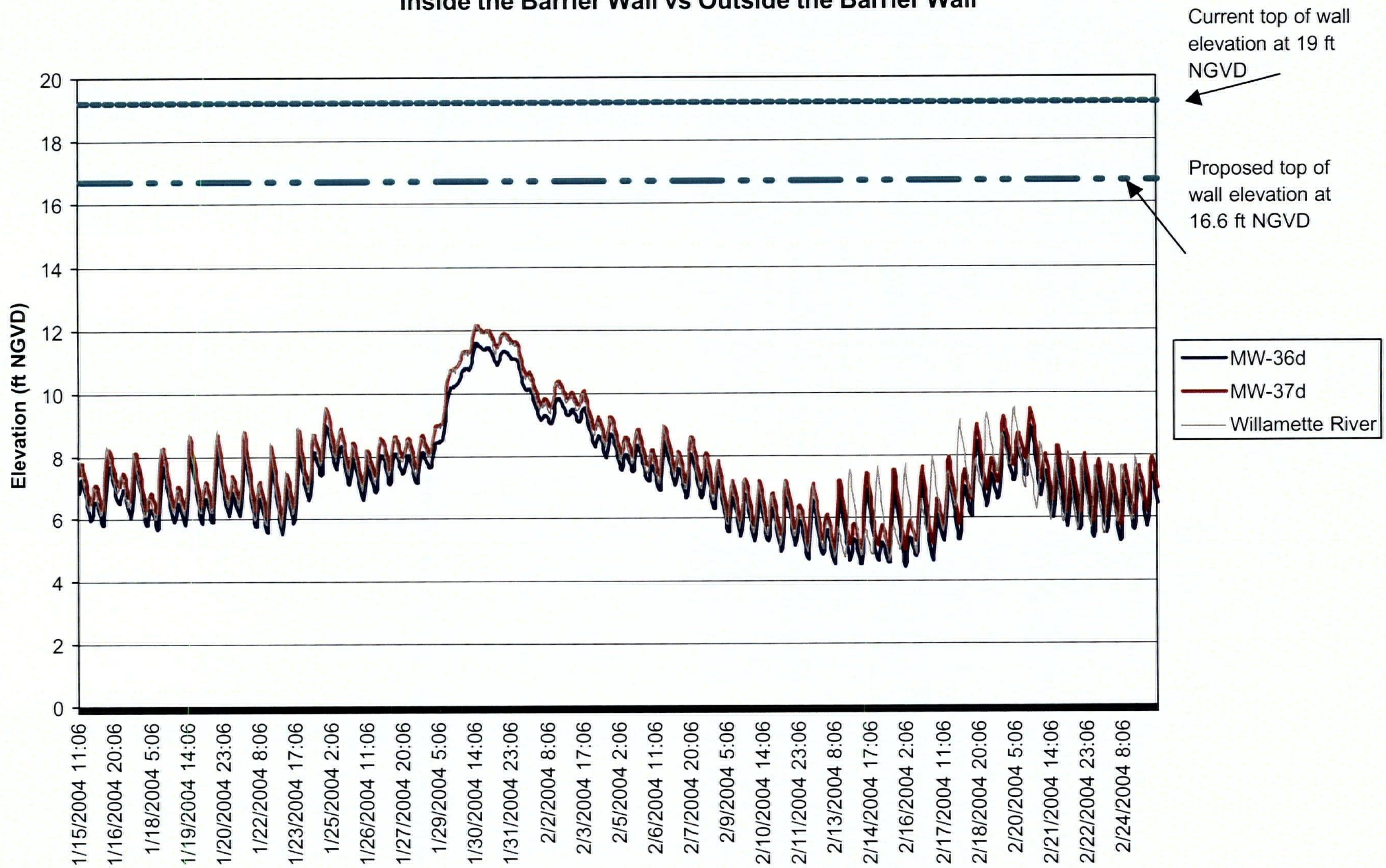
McCORMICK AND BAXTER CREOSOTING COMPANY

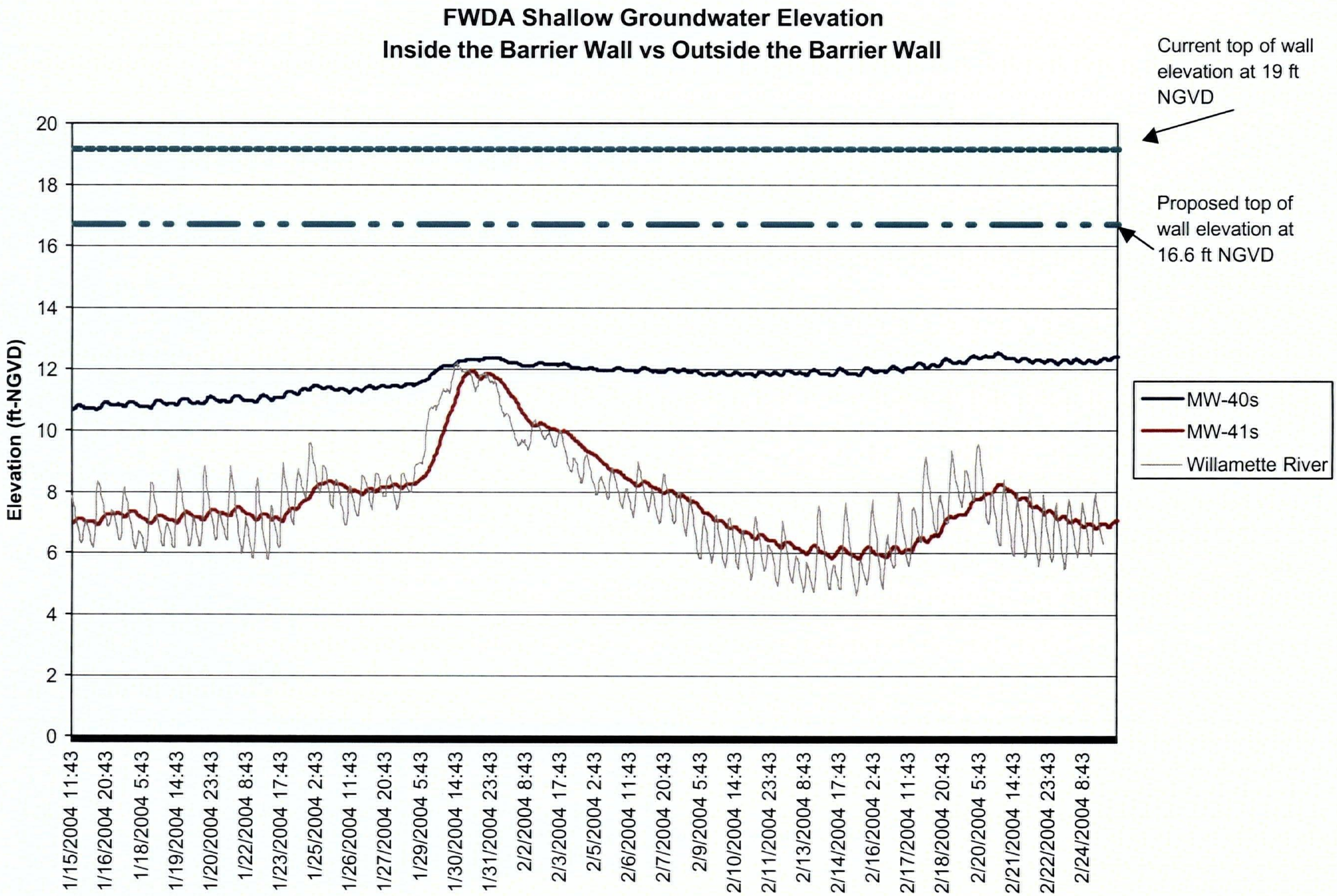
FWDA Shallow Groundwater Elevation
Inside the Barrier Wall vs Outside the Barrier Wall



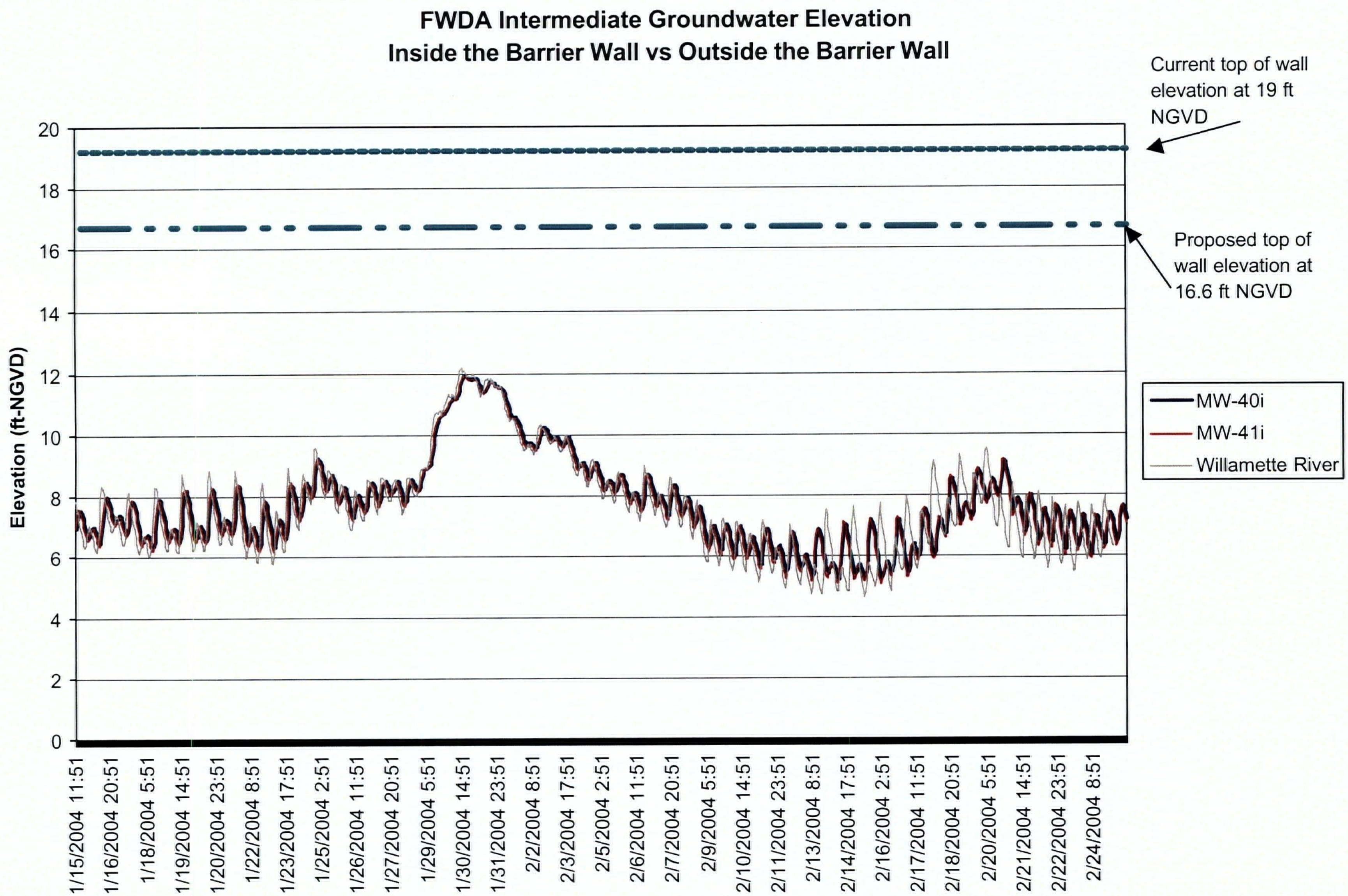

FWDA Intermediate Groundwater Elevation
Inside the Barrier Wall vs Outside the Barrier Wall
Current top of wall elevation at 19 ft NGVD
Proposed top of wall elevation at 16.6 ft NGVD
Elevation (ft-NGVD)
20
18
16
14
12
10
8
6
4
2
0
MW-36i
MW-37i
Willamette River
1/15/2004 11:07
1/16/2004 20:07
1/18/2004 5:07
1/19/2004 14:07
1/20/2004 23:07
1/22/2004 8:07
1/23/2004 17:07
1/25/2004 2:07
1/26/2004 11:07
1/27/2004 20:07
1/29/2004 5:07
1/30/2004 14:07
1/31/2004 23:07
2/2/2004 8:07
2/3/2004 17:07
2/5/2004 2:07
2/6/2004 11:07
2/7/2004 20:07
2/9/2004 5:07
2/10/2004 14:07
2/11/2004 23:07
2/13/2004 8:07
2/14/2004 17:07
2/16/2004 2:07
2/17/2004 11:07
2/18/2004 20:07
2/20/2004 5:07
2/21/2004 14:07
2/22/2004 23:07
2/24/2004 8:07

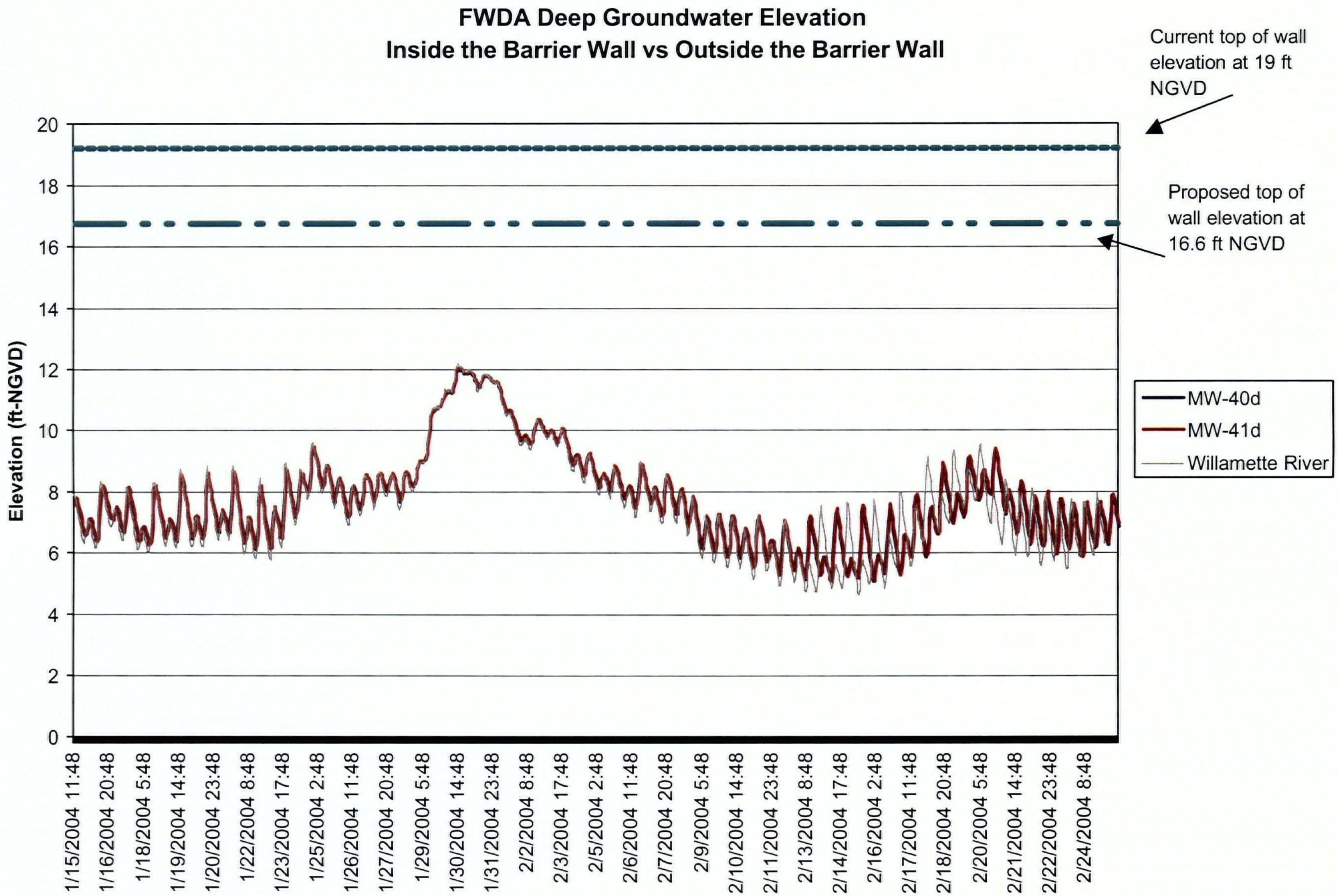
FWDA Deep Groundwater Elevation
Inside the Barrier Wall vs Outside the Barrier Wall



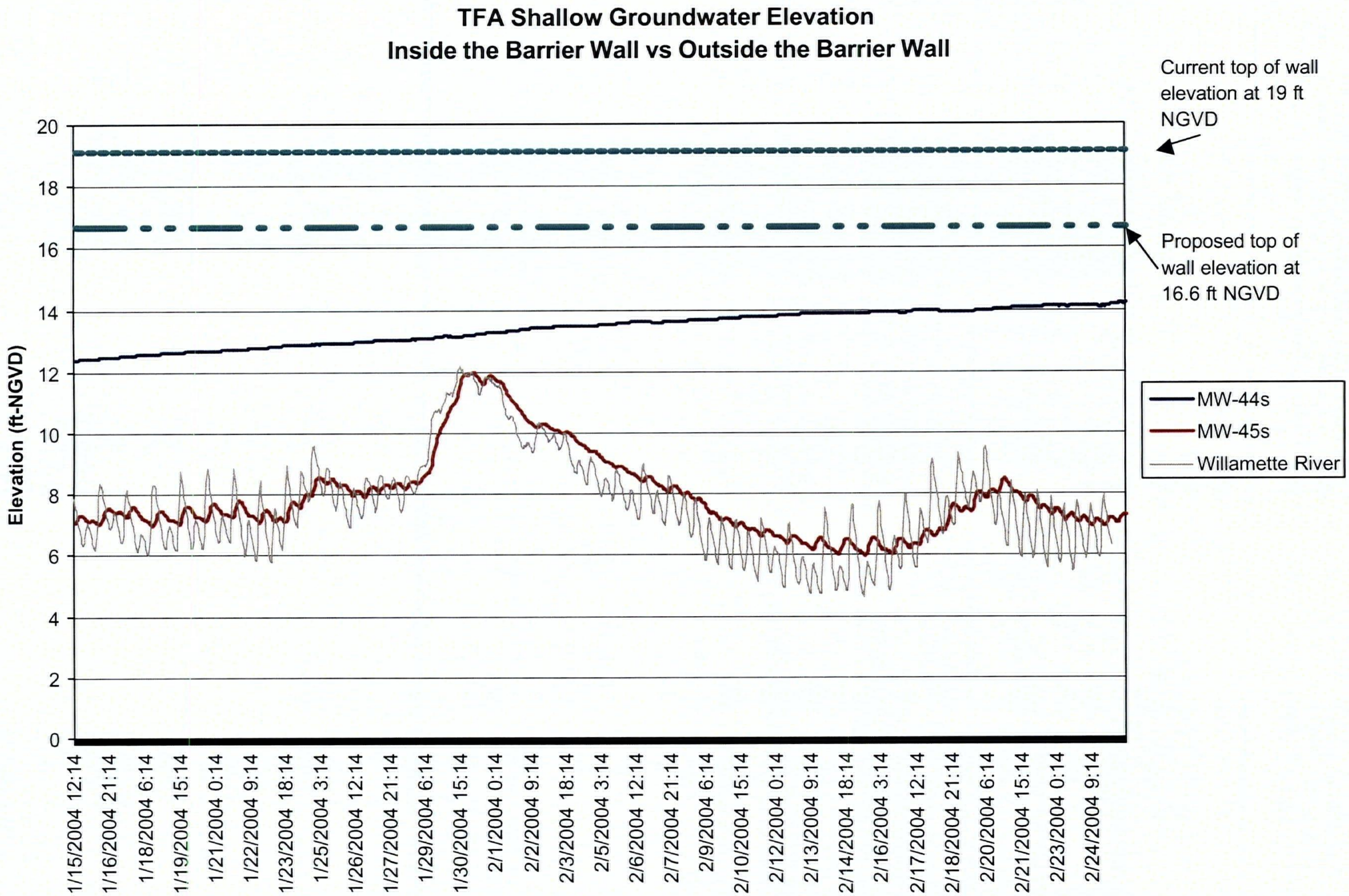


FWDA Shallow Groundwater Elevation
Inside the Barrier Wall vs Outside the Barrier Wall
Current top of wall elevation at 19 ft NGVD
Proposed top of wall elevation at 16.6 ft NGVD
Elevation (ft-NGVD)
20
18
16
14
12
10
8
6
4
2
0
MW-40s
MW-41s
Willamette River
1/15/2004 11:43
1/16/2004 20:43
1/18/2004 5:43
1/19/2004 14:43
1/20/2004 23:43
1/22/2004 8:43
1/23/2004 17:43
1/25/2004 2:43
1/26/2004 11:43
1/27/2004 20:43
1/29/2004 5:43
1/30/2004 14:43
1/31/2004 23:43
2/2/2004 8:43
2/3/2004 17:43
2/5/2004 2:43
2/6/2004 11:43
2/7/2004 20:43
2/9/2004 5:43
2/10/2004 14:43
2/11/2004 23:43
2/13/2004 8:43
2/14/2004 17:43
2/16/2004 2:43
2/17/2004 11:43
2/18/2004 20:43
2/20/2004 5:43
2/21/2004 14:43
2/22/2004 23:43
2/24/2004 8:43

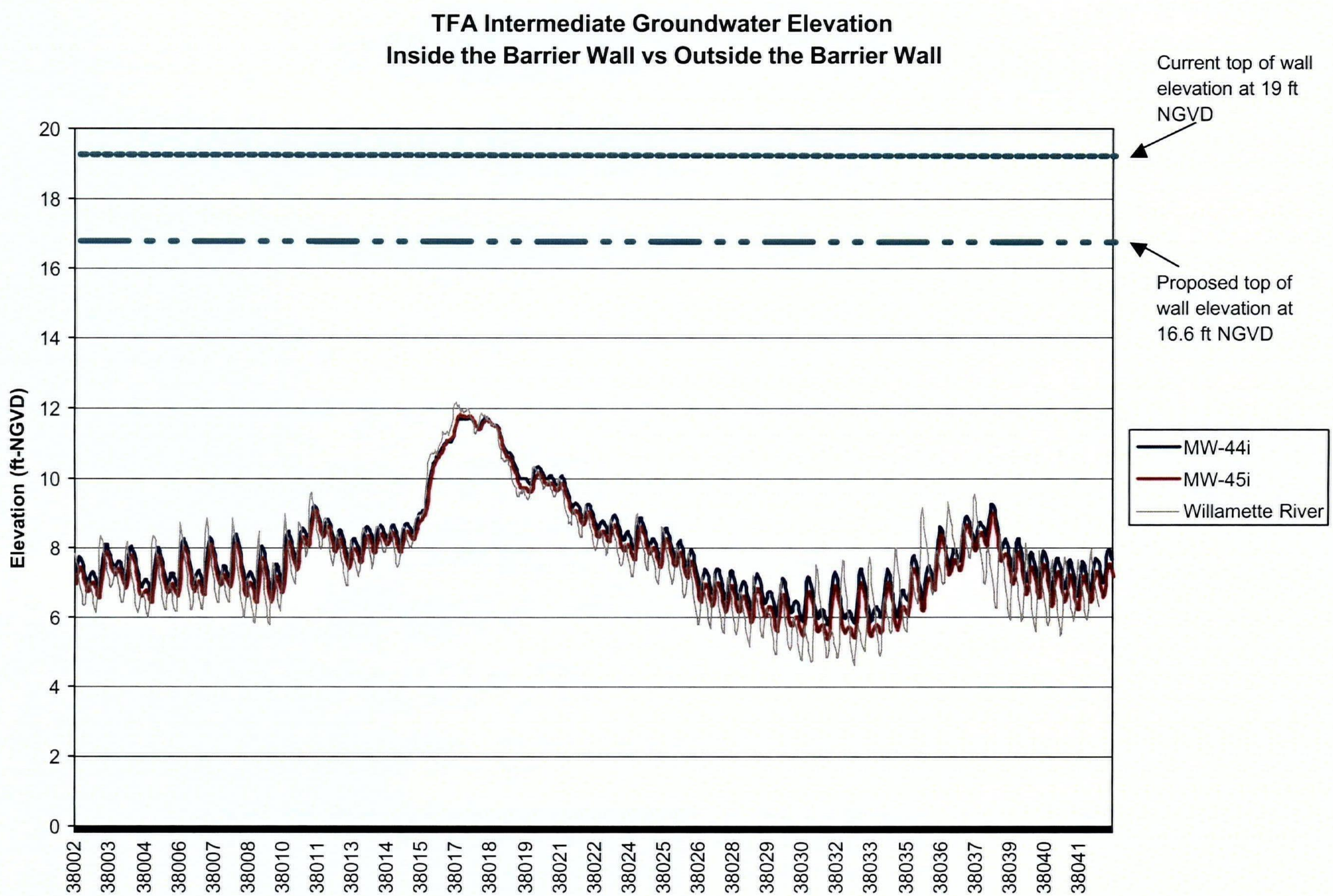

FWDA Intermediate Groundwater Elevation
Inside the Barrier Wall vs Outside the Barrier Wall
Current top of wall elevation at 19 ft NGVD
Proposed top of wall elevation at 16.6 ft NGVD
Elevation (ft-NGVD)
20
18
16
14
12
10
8
6
4
2
0
MW-40i
MW-41i
Willamette River
1/15/2004 11:51
1/16/2004 20:51
1/18/2004 5:51
1/19/2004 14:51
1/20/2004 23:51
1/22/2004 8:51
1/23/2004 17:51
1/25/2004 2:51
1/26/2004 11:51
1/27/2004 20:51
1/29/2004 5:51
1/30/2004 14:51
1/31/2004 23:51
2/2/2004 8:51
2/3/2004 17:51
2/5/2004 2:51
2/6/2004 11:51
2/7/2004 20:51
2/9/2004 5:51
2/10/2004 14:51
2/11/2004 23:51
2/13/2004 8:51
2/14/2004 17:51
2/16/2004 2:51
2/17/2004 11:51
2/18/2004 20:51
2/20/2004 5:51
2/21/2004 14:51
2/22/2004 23:51
2/24/2004 8:51

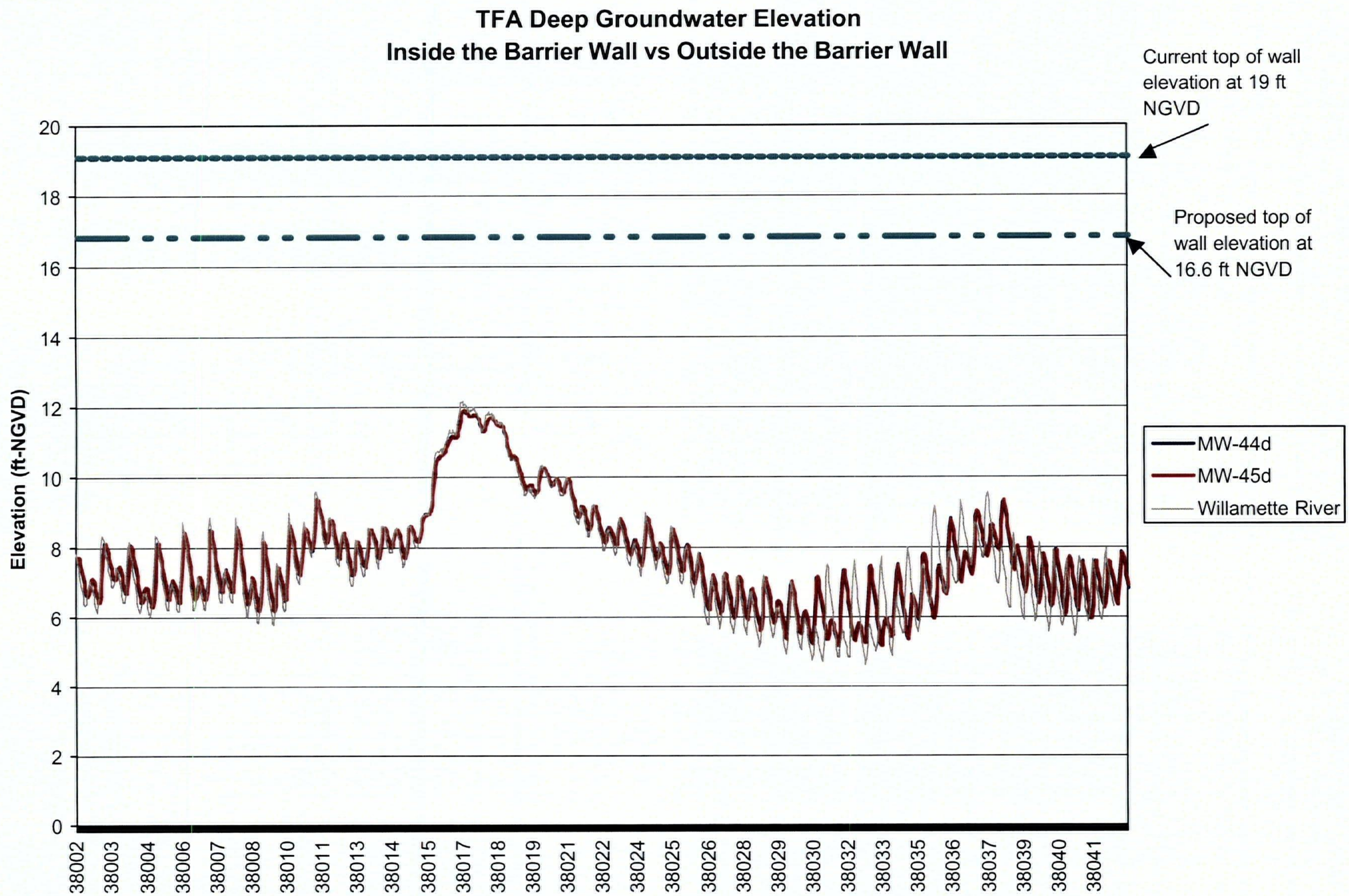


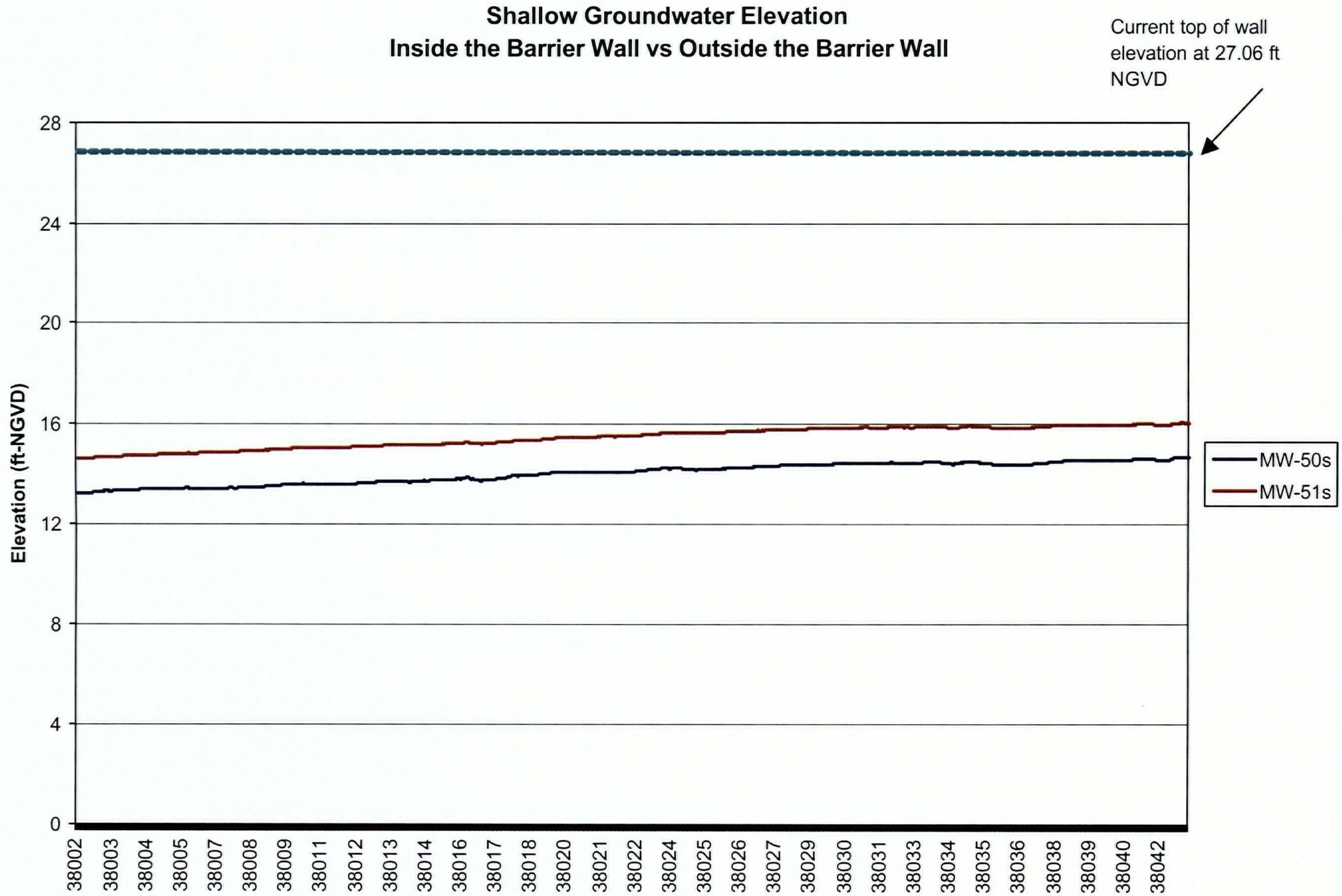
FWDA Deep Groundwater Elevation
Inside the Barrier Wall vs Outside the Barrier Wall
Current top of wall elevation at 19 ft NGVD
Proposed top of wall elevation at 16.6 ft NGVD
Elevation (ft-NGVD)
MW-40d
MW-41d
Willamette River
0
2
4
6
8
10
12
14
16
18
20
1/15/2004 11:48
1/16/2004 20:48
1/18/2004 5:48
1/19/2004 14:48
1/20/2004 23:48
1/22/2004 8:48
1/23/2004 17:48
1/25/2004 2:48
1/26/2004 11:48
1/27/2004 20:48
1/29/2004 5:48
1/30/2004 14:48
1/31/2004 23:48
2/2/2004 8:48
2/3/2004 17:48
2/5/2004 2:48
2/6/2004 11:48
2/7/2004 20:48
2/9/2004 5:48
2/10/2004 14:48
2/11/2004 23:48
2/13/2004 8:48
2/14/2004 17:48
2/16/2004 2:48
2/17/2004 11:48
2/18/2004 20:48
2/20/2004 5:48
2/21/2004 14:48
2/22/2004 23:48
2/24/2004 8:48



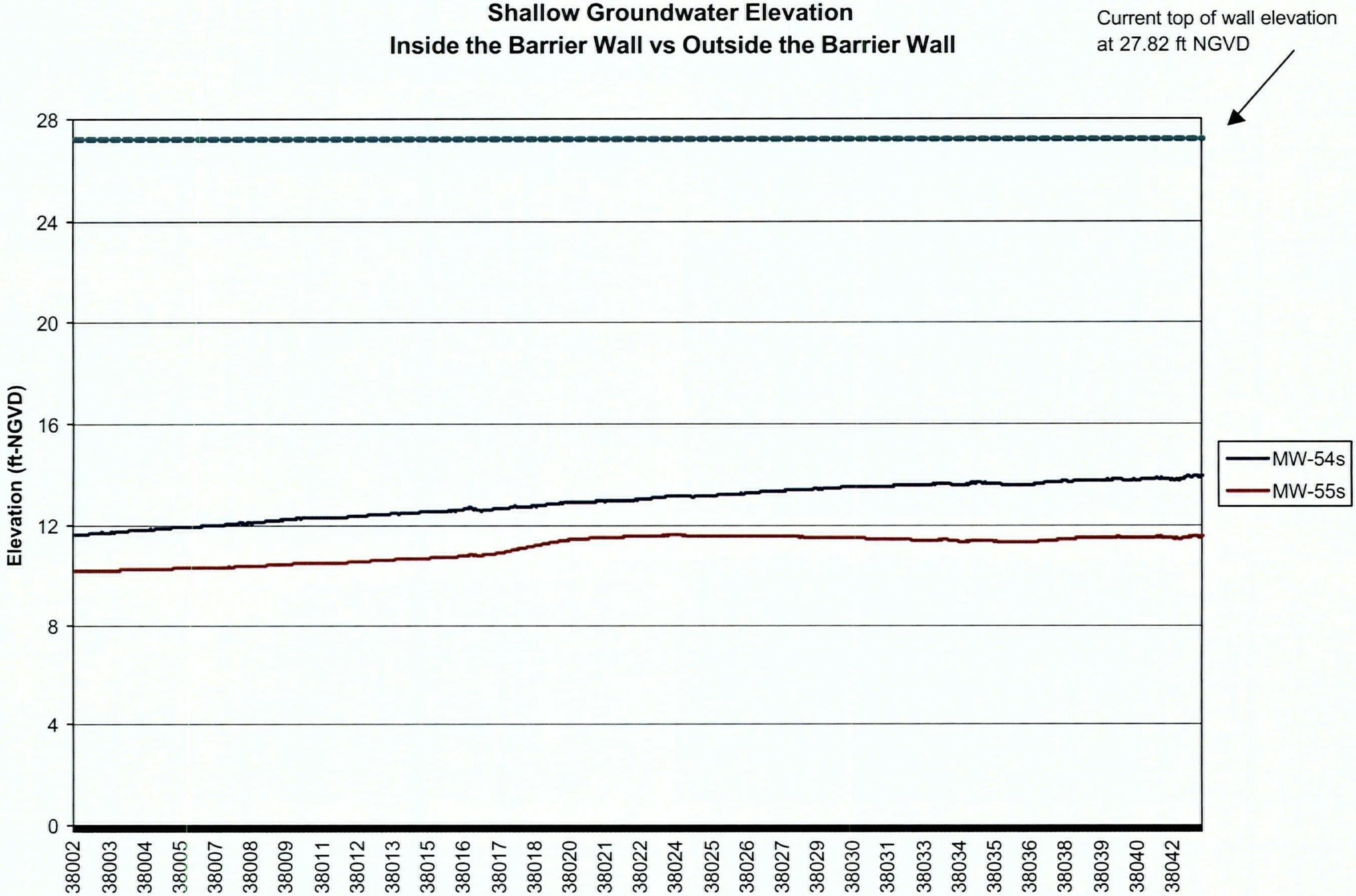
TFA Shallow Groundwater Elevation
Inside the Barrier Wall vs Outside the Barrier Wall
Current top of wall elevation at 19 ft NGVD
Proposed top of wall elevation at 16.6 ft NGVD
Elevation (ft-NGVD)
20
18
16
14
12
10
8
6
4
2
0
MW-44s
MW-45s
Willamette River
1/15/2004 12:14
1/16/2004 21:14
1/18/2004 6:14
1/19/2004 15:14
1/21/2004 0:14
1/22/2004 9:14
1/23/2004 18:14
1/25/2004 3:14
1/26/2004 12:14
1/27/2004 21:14
1/29/2004 6:14
1/30/2004 15:14
2/1/2004 0:14
2/2/2004 9:14
2/3/2004 18:14
2/5/2004 3:14
2/6/2004 12:14
2/7/2004 21:14
2/9/2004 6:14
2/10/2004 15:14
2/12/2004 0:14
2/13/2004 9:14
2/14/2004 18:14
2/16/2004 3:14
2/17/2004 12:14
2/18/2004 21:14
2/20/2004 6:14
2/21/2004 15:14
2/23/2004 0:14
2/24/2004 9:14

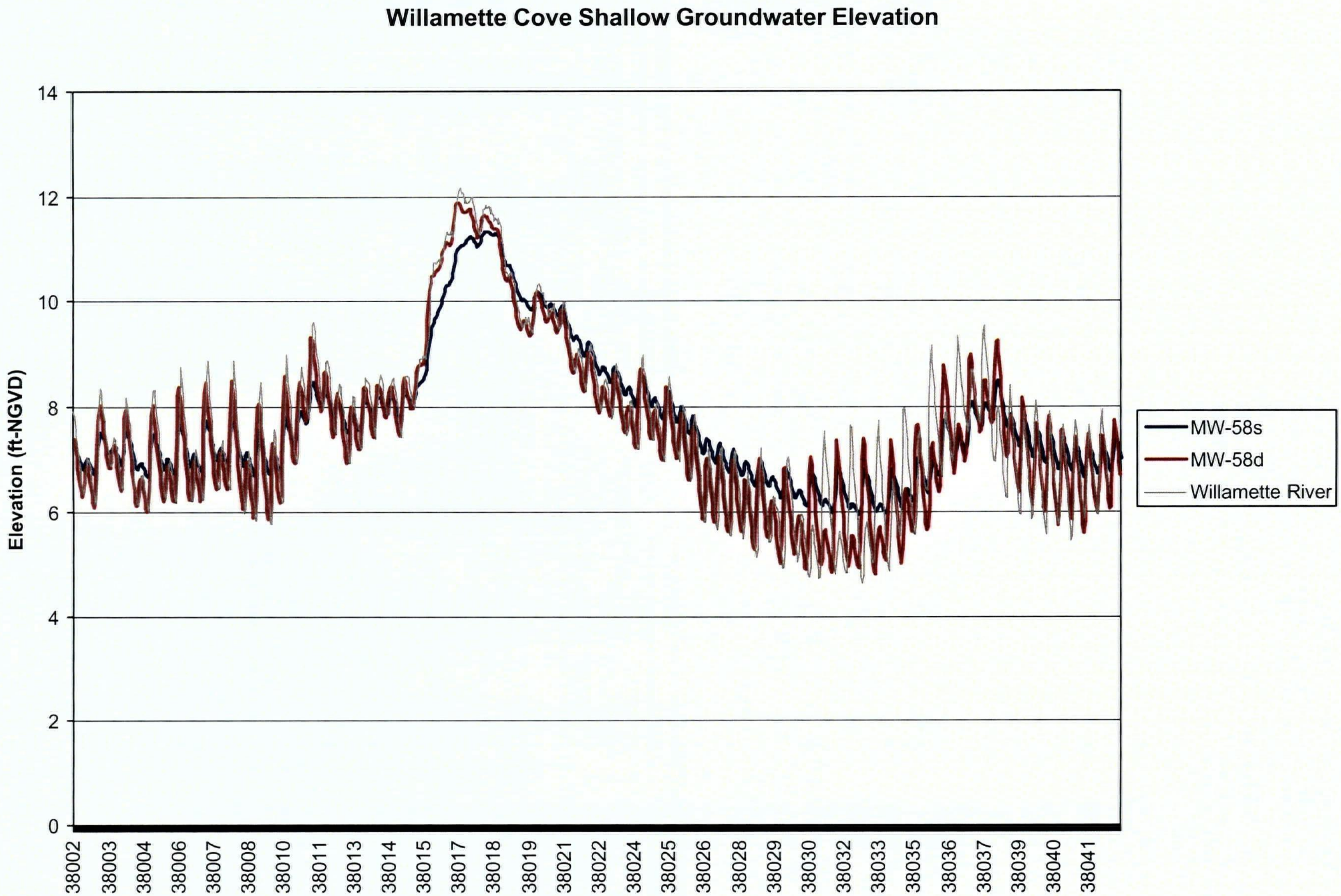

TFA Intermediate Groundwater Elevation
Inside the Barrier Wall vs Outside the Barrier Wall
Current top of wall elevation at 19 ft NGVD
Proposed top of wall elevation at 16.6 ft NGVD
Elevation (ft-NGVD)
20
18
16
14
12
10
8
6
4
2
0
MW-44i
MW-45i
Willamette River
38002
38003
38004
38006
38007
38008
38010
38011
38013
38014
38015
38017
38018
38019
38021
38022
38024
38025
38026
38028
38029
38030
38032
38033
38035
38036
38037
38039
38040
38041


TFA Deep Groundwater Elevation
Inside the Barrier Wall vs Outside the Barrier Wall
Current top of wall elevation at 19 ft NGVD
Proposed top of wall elevation at 16.6 ft NGVD
Elevation (ft-NGVD)
20
18
16
14
12
10
8
6
4
2
0
MW-44d
MW-45d
Willamette River
38002
38003
38004
38006
38007
38008
38010
38011
38013
38014
38015
38017
38018
38019
38021
38022
38024
38025
38026
38028
38029
38030
38032
38033
38035
38036
38037
38039
38040
38041


Shallow Groundwater Elevation
Inside the Barrier Wall vs Outside the Barrier Wall
Current top of wall elevation at 27.06 ft NGVD
Elevation (ft-NGVD)
28
24
20
16
12
8
4
0
38002
38003
38004
38005
38007
38008
38009
38011
38012
38013
38014
38016
38017
38018
38020
38021
38022
38024
38025
38026
38027
38029
38030
38031
38033
38034
38035
38036
38038
38039
38040
38042
MW-50s
MW-51s

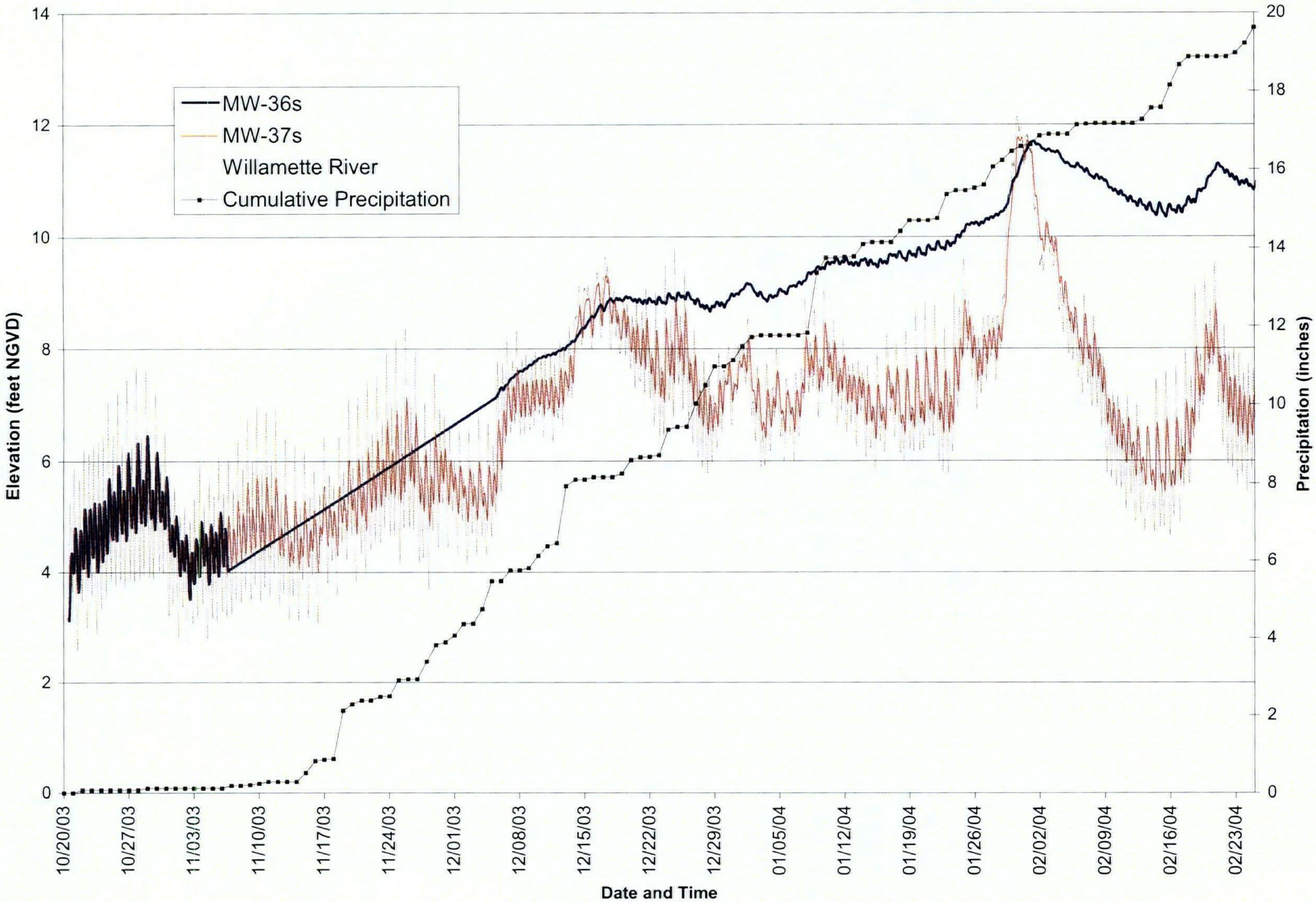
Shallow Groundwater Elevation
Inside the Barrier Wall vs Outside the Barrier Wall



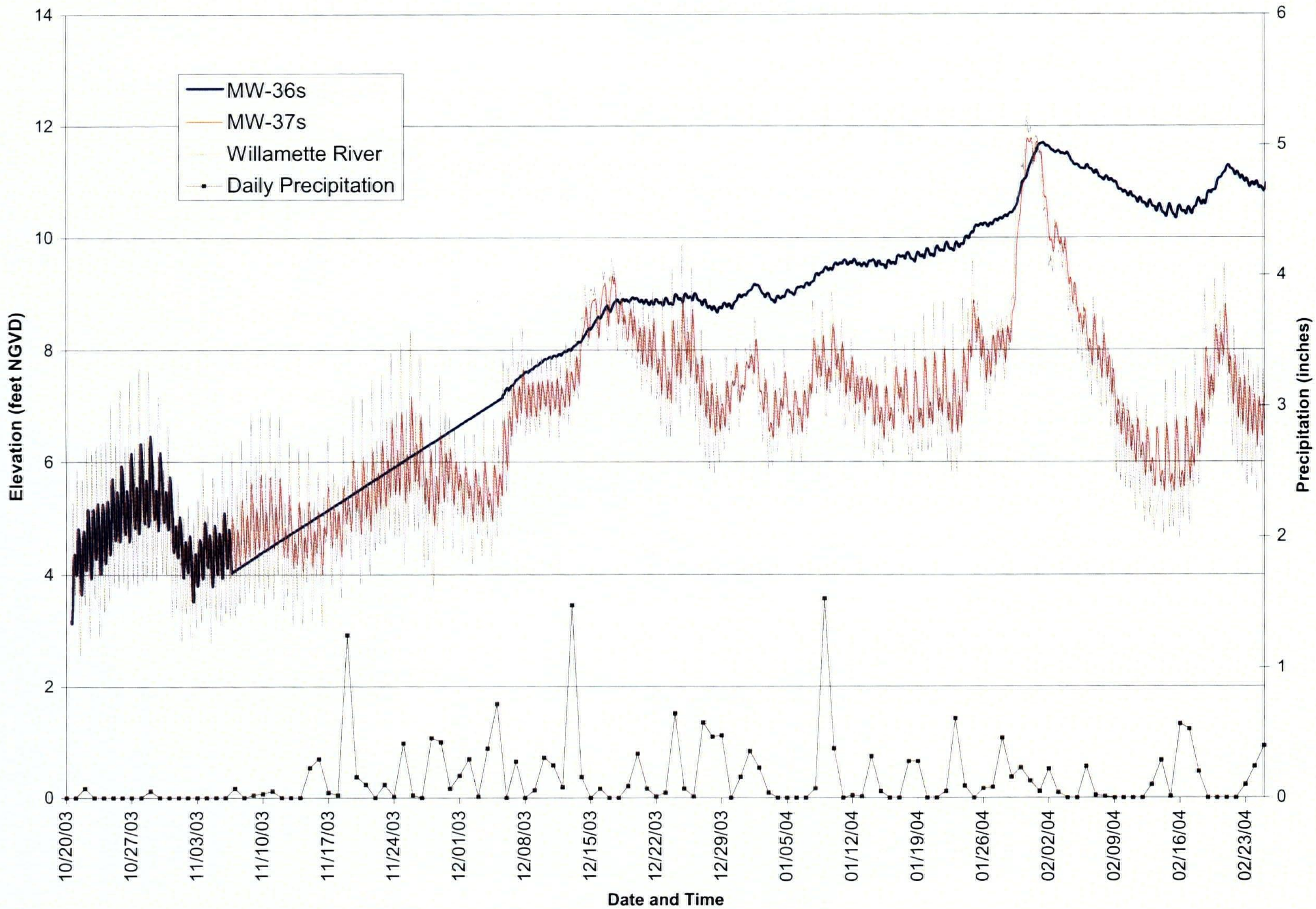


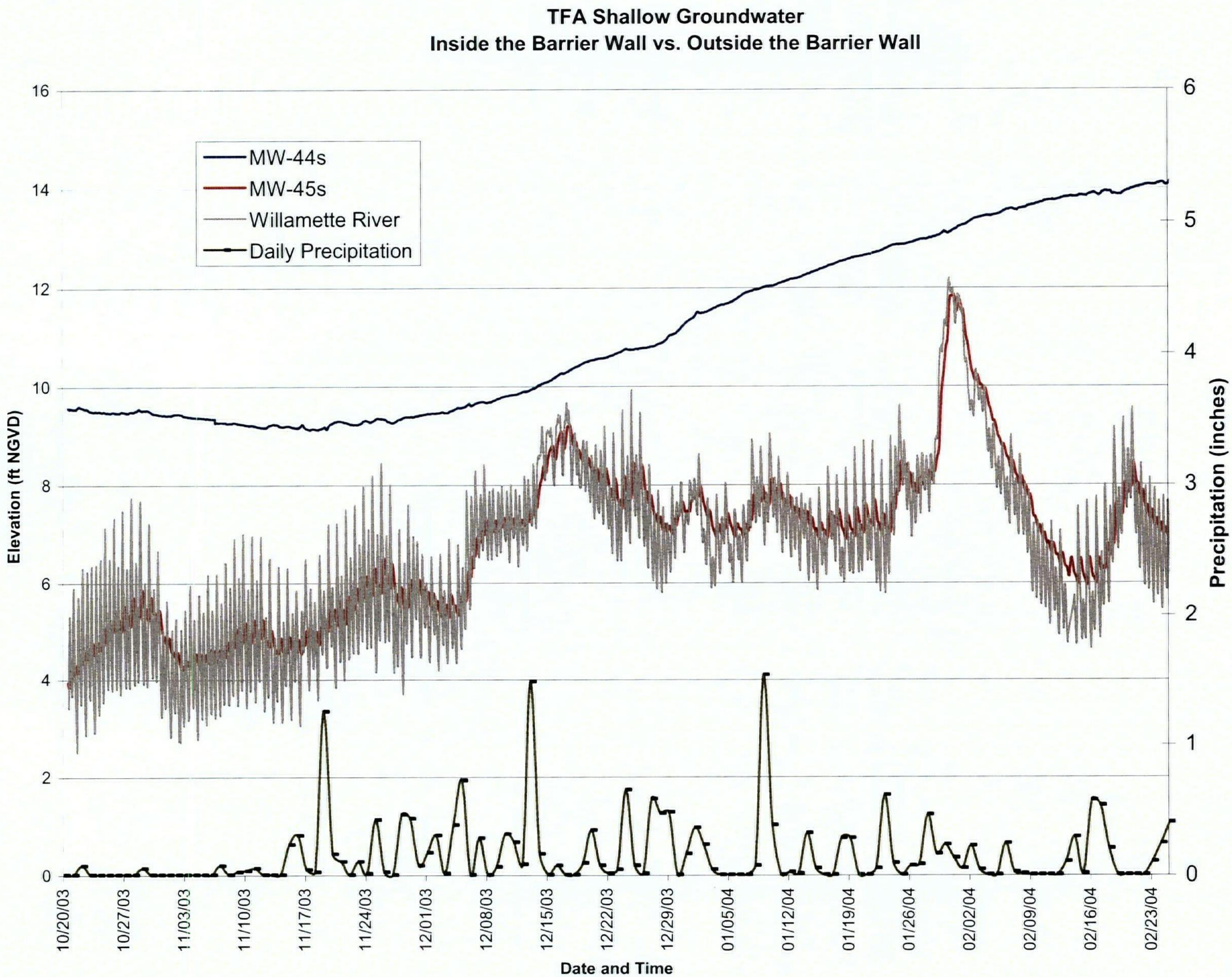
Willamette Cove Shallow Groundwater Elevation
Elevation (ft-NGVD)
14
12
10
8
6
4
2
0
38002
38003
38004
38006
38007
38008
38010
38011
38013
38014
38015
38017
38018
38019
38021
38022
38024
38025
38026
38028
38029
38030
38032
38033
38035
38036
38037
38039
38040
38041
MW-58s
MW-58d
Willamette River

FWDA Shallow Groundwater
Inside the Barrier Wall vs Outside the Barrier Wall



FWDA Shallow Groundwater
Inside the Barrier Wall vs Outside the Barrier Wall





TFA Shallow Groundwater
Inside the Barrier Wall vs. Outside the Barrier Wall
MW-44s
MW-45s
Willamette River
Daily Precipitation
Elevation (ft NGVD)
Precipitation (inches)
Date and Time
16
14
12
10
8
6
4
2
0
6
5
4
3
2
1
0
10/20/03
10/27/03
11/03/03
11/10/03
11/17/03
11/24/03
12/01/03
12/08/03
12/15/03
12/22/03
12/29/03
01/05/04
01/12/04
01/19/04
01/26/04
02/02/04
02/09/04
02/16/04
02/23/04

TFA Shallow Groundwater
Inside the Barrier Wall vs. Outside the Barrier Wall